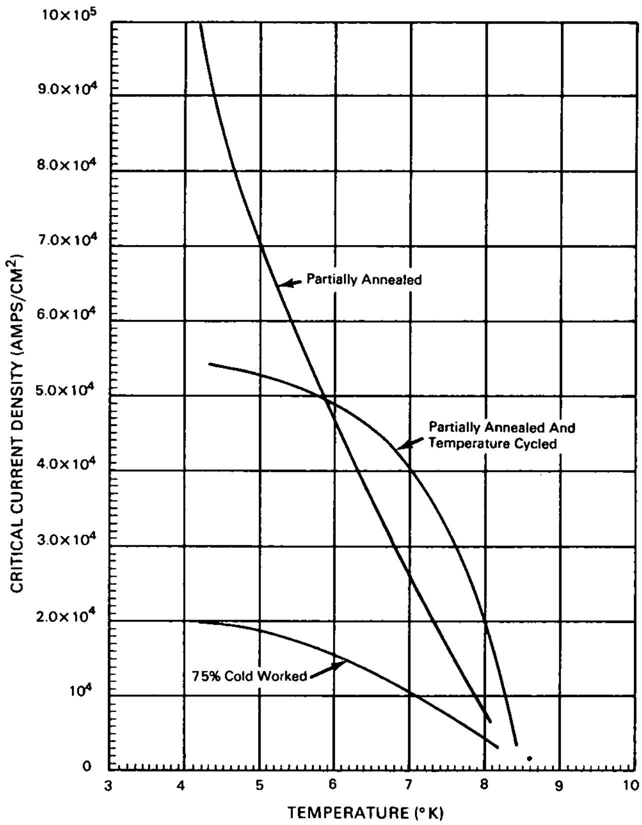
NASA TECH BRIEF

Simple Technique Determines AC Properties of Hard Superconductive Materials



The problem:

To ascertain the superconducting properties of materials when subjected to time-varying magnetic fields. According to present theory the hard superconductor in a magnetic field may be characterized by a vortex lattice, extending throughout the material and having a single unit of magnetic flux at the center of each vortex. These vortices move dissipatively so that the properties of the material in a time-varying field, which cause vortices to move constantly, are expected to be very much different from those in a steady field. Knowledge of ac properties of the material is essential if device applications are to be realized. The technique described here affords a straightforward means of determining these ac properties, which are principally the critical current density in an ac field and the effective resistivity which characterizes the state in which flux is in motion.

(continued overleaf)

The solution:

Samples of NbTi alloy, HI-120, are examined and the critical current density (J_C) for the samples is analyzed from magnetization curves. A complete family of magnetization curves is obtained, each curve representing performance at a different temperature.

How it's done:

The superconductive material is worked into a tubular specimen, which is then placed within a small coil wound on a nonmagnetic coil form. A magnetic field sensor in the form of a Hall-effect probe occupies the space within the tube and the coil–specimen–probe package is placed in the base of a large solenoid. This solenoid establishes a large enough dc field to place the specimen in the mixed state, in which flux permeates the bulk of the material. The ac coil is then energized and the value of the ac field at which an ac voltage begins to appear on the probe is noted. This represents the maximum ac field which the specimen can shield at the given frequency and may be related to the critical current density through the following expression:

$$J_C = \frac{H}{0.4d}$$

where J_C is the critical current density in amp/cm^2 that flows in the presence of an ac field of peak value H oersteds in a sample whose wall thickness is d cm.

Note:

Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B66-10657

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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